# DECLARATION

I, the undersigned, Tomoko MOKUDAI, residing at 2-45-1-402 Toyoda, Hino-shi, Tokyo, JAPAN, do solemnly and sincerely declare that I well understand the Japanese Language and the English language and that the attached English translation of a certified copy of Japanese Patent Application No. 2000-135222 is true, correct and faithful translation to the best of my knowledge and belief from the Japanese language into the English language.

Dated this 23rd day of April, 2004

Tomoko Mokudai

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PATENT OFFICE

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[Title of the Invention] Liquid Processing Apparatus and Liquid Processing Method

[Claims]

[Claim 1]

A liquid processing apparatus comprising:

processing target holding means for holding a processing target and capable of rotating the processing target on a plane of the processing target;

first processing liquid supply means for supplying a first processing liquid to a central region of the processing target while the processing target is held and rotated by said processing target holding means; and

second processing liquid supply means for supplying a second processing liquid to an edge of the processing target while said first processing liquid supply means supplies the first processing liquid to the central region of the processing target.

[Claim 2]

The liquid processing apparatus according to claim 1, wherein the first processing liquid is pure water, and the second processing liquid is a mixture liquid of hydrogen peroxide solution and acid-base solution.

[Claim 3]

The liquid processing apparatus according to claim 1, wherein said second processing liquid supply means supplies the processing liquid to the edge of the processing target at an acute angle to the plane of the processing target.

[Claim 4]

The liquid processing apparatus according to claim 1, wherein said second processing liquid supply means supplies the processing liquid to the edge of the processing target at an angle of 0 to 90° to a tangential direction of the plane of the processing target on the plane of the processing target.

[Claim 5]

The liquid processing apparatus according to claims 1 to 4, comprising third processing liquid supply means which includes:

a plurality of pipes having a center and extending from the center outwardly in a radial direction; and

a plurality of holes which are provided in an upper side of said pipes at regular intervals, for supplying a processing liquid to a surface of the processing target.

[Claim 6]

The liquid processing apparatus according to claim 5, wherein said plurality of holes are provided in said pipes such that said holes have diameters which are increased from the center outwardly in a radial direction.

[Claim 7]

A liquid processing method employing a liquid processing apparatus which comprises:

processing target holding means for holding a processing target and capable of rotating the processing target on a plane of the processing target;

first processing liquid supply means for supplying a first processing liquid to a central region of the processing target while the processing target is held and rotated by said processing target holding means; and

second processing liquid supply means for supplying a second processing liquid to an edge of the processing target while said first processing means supplies the first processing liquid to the central region of the processing target, said method comprising:

processing the edge of the processing target while said processing target holding means holds the processing target and rotates the processing target at a first rotation speed; and

processing the edge of the processing target by rotating the processing target at a second rotation speed different from the first rotation speed to shift a position of the processing target that is held by said processing target holding

means.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a liquid processing apparatus and liquid processing method.

[0002]

[Prior Art]

A manufacturing process of an electronic device such as a semiconductor, etc. includes a process for forming a thin film on a substrate such as a wafer, etc. For example, manufacture of a semiconductor wafer having a metal wiring includes a process for forming a metal thin film by plating, after formation of a seed layer by PVD or the like.

[0003]

In the manufacturing process of a semiconductor device, if a thin film at the edge remains present without being removed, the thin film, at the time of transfer, might be peeled and scattered by contact to the carrier, producing particles which may pollute the carrier and the device.

[0004]

Particularly, in the process for manufacturing a Cu wiring of a semiconductor wafer, the above problem is critical because Cu has a great influence upon Si and $SiO_2$. As shown in FIG. 7, a Cu seed layer 72 and a Cu plated layer 71 are present at an edge 73 of a wafer immediately after being plated, and the carrier or the like might be polluted by Cu if these unnecessary films are peeled.

[0005]

The above-described pollution of the device due to the thin films peeled from the edge leads to a reduction in the yield of the device, in a trend toward a higher density of devices. Therefore, it is necessary to remove the thin films

at the edge by washing (etching) the edge of the substrate.

[0006]

As a washing method for a substrate edge for the above purpose, there is known a method of splashing a resist solvent to the edge of a substrate onto which a resist film is applied, thereby to remove the unnecessary film at the edge of the substrate. This method is for carrying out a washing process by splashing a resist solvent to the edge from a nozzle or the like from above the surface of the substrate.

[0007]

[Problem to be Solved by the Invention]

However, the above-described method is a method relating to removal of a resist film by a solvent, and can not simply be applied to washing of the edge of a plated substrate on which formed a metal thin film which requires a chemical reaction to be removed. Further, in a case where this method is used for washing the edge of a plated substrate, there is a problem that the splashed washing liquid and the dissolved material of the thin film scatter onto the surface of the substrate and give an adverse influence onto a device manufacture area.

[0008]

Accordingly, the object of the present invention is to provide a liquid processing apparatus for a substrate which can wash the edge of a substrate without causing an adverse influence to a device.

Another object of the present invention is to provide a liquid processing apparatus for a semiconductor substrate, which can be applied to a plating apparatus and which can wash the edge of a semiconductor substrate without causing an adverse influence to a device.

[0009]

[Means for Solving the Problem]

To solve the above-described problem, a liquid processing apparatus

according to the present invention is characterized by comprising:

processing target holding means for holding a processing target and capable of rotating the processing target on a plane of the processing target;

first processing liquid supply means for supplying a first processing liquid to a central region of the processing target while the processing target is held and rotated by said processing target holding means; and

second processing liquid supply means for supplying a second processing liquid to an edge of the processing target while said first processing liquid supply means supplies the first processing liquid to the central region of the processing target.

[0010]

According to the above-described structure, since a processing liquid is splashed onto the edge of a processing target while splashing to the central region of the surface of the processing target, an inert processing liquid such as pure water, etc. which does not give an adverse influence to a region of the processing target that has been subjected to a predetermined process, it is possible to wash the edge of the processing target while preventing the splashed processing liquid and dissolved products of thin films from scattering to the central region of the processing target.

[0011]

In the above-described liquid processing apparatus, it is preferred that the first processing liquid be pure water, and the second processing liquid be a mixture liquid of hydrogen peroxide solution and acid-base solution.

[0012]

According to the above-described structure, it is possible to remove a metal thin film on the edge of a substrate without giving an adverse influence to a plated surface of the substrate.

[0013]

In the above-described liquid processing apparatus, it is preferred that said

second processing liquid supply means supply the processing liquid to the edge of the processing target at an acute angle to the plane of the processing target.

[0014]

In the above-describe liquid processing apparatus, it is preferred that said second processing liquid supply means supply the processing liquid to the edge of the processing target at an angle of 0 to 90° to a tangential direction of the plane of the processing target on the plane of the processing target.

[0015]

The above-described liquid processing apparatus is characterized by comprising third processing liquid supply means which includes:

a plurality of pipes having a center and extending from the center outwardly in a radial direction; and

a plurality of holes which are provided in an upper side of said pipes at regular intervals, for supplying a processing liquid to a surface of the processing target.

[0016]

According to the above-described structure, it is possible to sufficiently wash the entire surfaces of the processing target to be liquid-processed since the processing liquid is splashed to the entire surfaces of the processing target.

[0017]

In the above-described liquid processing apparatus, it is preferred that said plurality of holes be provided in said pipes such that said holes have diameters which are increased from the center outwardly in a radial direction.

[0018]

A liquid processing method according to the present invention is a liquid processing method which employs a liquid processing apparatus comprising:

processing target holding means for holding a processing target and capable of rotating the processing target on a plane of the processing target;

first processing liquid supply means for supplying a first processing liquid to a central region of the processing target while the processing target is held and rotated by said processing target holding means; and

second processing liquid supply means for supplying a second processing liquid to an edge of the processing target while said first processing means supplies the first processing liquid to the central region of the processing target, and which method is characterized by comprising

processing the edge of the processing target while said processing target holding means holds the processing target and rotates the processing target at a first rotation speed; and

processing the edge of the processing target by rotating the processing target at a second rotation speed different from the first rotation speed to shift a position of the processing target that is held by said processing target holding means.

[0019]

According to the above-described method, when the edge of the processing target is liquid-processed while the processing target is rotated, by changing the number of rotations of the processing target to weaken the pushing force applied to the held portion of the processing target that is held and to shift the portion of the processing target to be held, it is possible to liquid-process the portion of the processing target that has been held.

[0020]

[Embodiments of the Invention]

A plating apparatus including a washing apparatus for a semiconductor substrate according to an embodiment of the present invention will be explained below with reference to the drawings.

[0021]

FIG. 1 to FIG. 3 are diagrams showing the entire structure of a plating apparatus 11 including a washing apparatus for a semiconductor substrate

according to the embodiment of the present invention, where FIG. 1 is a three-dimensional cubic diagram, FIG. 2 is a plan view, and FIG. 3 is a side view.

As shown, the plating apparatus 11 comprises a cassette station 21 and a processing station 22.

[0022]

The cassette station 21 transfers wafers, which are loaded from the outside into the apparatus 11 in a unit of wafer cassette, from a cassette 23a into the plating apparatus 11, or transfers wafers, which have been plated, from the plating apparatus 11 out to a cassette 23b.

[0023]

The cassette station 21 is provided with a cassette mounting 24, on which the wafer cassette 23a storing wafers to be plated is loaded from the outside. Further, plated wafers are stored into the cassette 23b for out-transfer on the mounting 24.

[0024]

Transfer of wafers on the above-described mounting 24 is conducted by a first transfer mechanism 25. The first transfer mechanism 25 can be moved in an x-axial direction and can be lifted upward and downward in a z-axial direction, so that it can access a plurality of wafer cassette 23 mounted on the mounting 24. Further, the first transfer mechanism 25 can be rotated about the z axis so that it can transfer wafers from the processing station 22 to the mounting 24.

[0025]

The cassette station 21 and the processing station 22 have the interior atmosphere maintained clean by a down flow of clean air.

[0026]

The processing station 22 has, at predetermined locations, a plurality of plating units 26 for performing plating on a wafer one by one and a plurality of

washing/drying units 27 for performing washing and drying after the plating.

[0027]

In the plating units 26, plating is applied to wafers on which a seed layer is formed to form, for example, a Cu thin film on the wafers. In the washing/drying units 27, the front surface, the back surface, and the edge of a plated wafer are washed (etched) with a washing liquid such as a chemical, pure water, etc. and after the washing, the wafer is rotated at high speed under $N_2$ purge to dry the wafer.

[0028]

As shown in FIG. 2, the processing station 22 is provided with a second transfer mechanism 29 at the center, around which respective processing units are arranged radiately. Further, as shown in FIG. 1 and FIG. 3, the processing station is structured by an upper and a lower two stages. The upper stage and lower stage of the processing station 22 are respectively constituted by four processing units which are arranged radiately around the second transfer mechanism 29, and the processing station 22 has eight units.

[0029]

The embodiment shown in FIG. 1 and FIG. 3 illustrates an apparatus structure wherein four plating units 26 are arranged on the lower stage and two washing/drying units 27 and two extra units 28 are arranged on the upper stage.

[0030]

Transfer of wafers inside the processing station 22 is conducted by the second transfer mechanism 29. The second transfer mechanism 29 receives wafers which are transferred by the first transfer unit 25 from the cassette station 21 and then mounted on a mounting 30 in the processing station 22, and transfers them to any of the plating units 26 on the lower stage. After the plating is completed, the second transfer mechanism 29 further transfers the wafers to the washing/drying units 27. Lastly, the second transfer mechanism

29 transfers the wafers which have been through the plating units 26 and washing/drying units 27 to the mounting 30, from which the first transfer mechanism 25 receives the wafers and stores them in a cassette 23. The first transfer mechanism may receive wafers from the washing/drying units directly, not via the mounting 30.

[0031]

The second transfer mechanism 29 can be rotated around the z axis and can be lifted upward and downward in the z-axial direction, so that it can access each processing unit in the processing station 22 having the two-stage structure.

[0032]

The second transfer mechanism 29 has three arms, one of which is dedicated to transfer of wafers from the mounting 30 to the plating units 26, another one of which is dedicated to transfer of wafers from the plating units 26 to the washing/drying units 27, and still another one of which is dedicated to transfer from the washing/drying units 27 to the mounting 30 in order to minimize pollution by particles, chemicals, etc.

[0033]

In the above-described embodiment, the apparatus structure is such that four plating units 26 are arranged on the lower stage, and two washing/drying units 27 and two extra units 28 are arranged on the upper stage. However, an apparatus structure wherein the extra units 28 are applied to other purposes is available. For example, a structure is available wherein four plating units 26 are arranged on the lower stage, and one plating unit 26 and three washing/drying units 27 are arranged on the upper stage.

[0034]

Further, the extra unit 28 may be such a processing unit as can be combined with the plating unit 26 and the washing/drying unit 27, for example an annealing unit for performing annealing after plating.

[0035]

A washing apparatus constituting the washing/drying unit 27 will be explained below. FIG. 4 shows the structure of a washing apparatus according to the present embodiment.

The washing apparatus of the present embodiment is structured such that a generally cylindrical cup 402 whose top surface is opened is provided in a square housing 401 in both sides of which inlet/outlet ports 417 having gate valves 416 are formed. This cup 402 can be driven upward and downward by a cup driving unit 403 which is controlled by a control unit 418.

[0036]

The control unit 418 is constituted by an arithmetic processing unit and a ROM or the like storing a processing program, etc., and controls the operation of the entire washing apparatus. Explanation of the functions of the control unit 418 will be omitted, in order to facilitate understanding of the entire apparatus.

[0037]

At the central position of the housing 401, a rotator 404 is provided. The rotator 404 is rotated at a given number of revolutions by the drive of a hollow motor 405 provided outside the housing 401. Above the rotator 404, a rotation table 406 is secured to the rotator 404 with a predetermined gap interval therebetween.

[0038]

In the interior of a first shaft 407 of the rotator 404, a second shaft 408 is formed. A back surface washing nozzle 409 is secured to the top of the second shaft 408. When a wafer W is held by a holding member, the back surface washing nozzle 409 is present between the wafer W and the rotation table 406.

[0039]

As shown in FIG. 5, the back surface washing nozzle 409 is structured such

that four rod members extend to the edge of the rotation table 406 crosswise from the portion at which the back surface washing nozzle 409 is secured to the second shaft 408. The rod members are hollow interiorly, and communicate with a pipe 410 which passes through the interior of the second shaft 408. Washing liquid is supplied through this pipe 410 upward from holes 51 which are opened in the upper side of the rod members of the back surface washing nozzle 409.

[0040]

Further, a gas channel 411 is formed in the space between the first shaft 407 and the second shaft 408, and an inert gas, for example, nitrogen gas is flowed out from the gas channel 411. The flowed-out inert gas flows to the edge of the rotation table 406 along the surface of the rotation table 406. Accordingly, the rotation table 406 also serves as a gas diffusion plate.

[0041]

Since the inert gas is flowed out from the center of the lower surface of the rotation table 406 outwardly and from the edge of the rotation table 406, i.e., from the edge of a wafer W outwardly during a rotation process, that is, during a time in which the wafer W is subjected to a washing process, it is possible to prevent particles or the like from invading to the back surface of the wafer W. Therefore, the back surface of the wafer W can be prevented from pollution.

An exhaust outlet 412 is provided in the space between the cup 402 and the rotator 404, and exhaust gas and exhaust gas including waste liquid of washing liquid or the like flow in the exhaust outlet 412.

[0042]

Three holding members 52 are attached to the edge portion of the rotation table 406 by supporting members 53 at an angle of 120 degrees at regular intervals (FIG. 5).

As shown in FIG. 6, the holding member 52 has a structure wherein a holding portion 54 at the upper side and a biasing portion 55 at the lower side

are integrated. The holding portion 54 has a step formed at its upper end, whereby the wafer W is held. The holding portion 54 is jointed to the supporting member 53 by a turning fulcrum 56 which is set at an upper end portion of the supporting member 53. The holding member 52 can turn around the turning fulcrum 56. The weight of the biasing portion 55 is set larger than that of the holding portion 54, thereby the biasing portion 55 serves as a plumb bob of the holding member 52.

[0043]

Since the wafer W is rotated at high speed by the rotator 404, the wafer W needs to be held stably. Because of this, the holding member 52 is so structured as not only to hold the wafer W by the step of the holding portion 54 but to hold the edge portion of the wafer W by the biasing of the biasing portion 55.

[0044]

That is, the wafer W, when it is not rotated, is mounted on the holding member 52 and held by the holding portion 54 of the holding member 52. Then, when the rotation table 406 is rotated, the biasing portion 55 tries to move farther outward due to centrifugal force that is exerted on the biasing portion 55, thereby the side of the holding portion 54 of the holding member 52 is pushed toward the center of the rotation table 406, which makes the wafer W be held more firmly.

Further, as illustrated, the holding portion 54 of the holding member 52 is formed to be prominent when seen from the front, and holds the wafer W at the step thereof by point contact.

[0045]

A main washing nozzle 414 and an edge washing nozzle 415 are provided above the rotation table 406.

The main washing nozzle 414 is connected to a first washing liquid tank 419, and discharges pure water stored in the first washing liquid tank from its

nozzle end at a predetermined supply rate. Further, the main washing nozzle 4 is set such that its nozzle end comes to the center of the wafer W when the wafer W is mounted on the rotation table, and is designed to be movable so as not to impede transfer of the wafer W by the second transfer mechanism 29.

[0046]

The edge washing nozzle 415 is connected to a second washing liquid tank 420, and discharges washing liquid stored in the second washing liquid tank 420 from its nozzle end at a predetermined supply rate. The washing liquid stored in the second washing liquid tank 420 is a mixture liquid of an acid-base chemical including inorganic acid such as hydrofluoric acid, hydrochloric acid, sulfuric acid, etc. and organic acid, and hydrogen peroxide solution ($H_2O_2$), for example, a mixture liquid of rare hydrofluoric acid and $H_2O_2$. In the present embodiment, a mixture liquid having a ratio of hydrofluoric acid : $H_2O_2$ : $H_2O$ = 1: 1: 23 is used.

[0047]

As shown in FIG. 7, on the surface of the edge of the wafer W, a Cu seed layer L1 and a Cu layer L2 which is formed thereon by plating are present. While the main washing nozzle 414 is supplying pure water onto the surface of the wafer W, the edge washing nozzle 415 discharges the washing liquid to the edge of the wafer W to wash (etch) the edge of the wafer W.

[0048]

The edge washing nozzle 415 is movable likewise the main washing nozzle. In the present embodiment, the edge washing nozzle 415 is arranged 2 cm apart from the edge of the wafer W and 1 cm above the wafer W. Further, the edge washing nozzle 415 is set at an acute angle, for example, at an angle of 30° with respect to the plane of the wafer W, and is set at an angle of 0 to 90°, for example, 45° with respect to the radial direction of the wafer W on the plane of the wafer W.

[0049]

By arranging the edge washing nozzle 415 as described above, it is possible to secure a desired washing width, for example, a washing width of around 2 mm at the edge of the wafer W, while preventing the washing liquid and dissolved products of the thin films from scattering onto the device manufacture area on the surface of the wafer W.

[0050]

The principal parts of the rotary washing apparatus according to the present embodiment are structured as described above, and the washing sequence of the apparatus will be explained with reference to FIG. 8.

A wafer W taken out from the plating unit is transferred by the second transfer mechanism 29 into the washing/drying unit 27 from the inlet/outlet port 417 of the housing 401 and then placed on the holding members 52 arranged at the edge portion of the rotation table 406, after which the second transfer mechanism 29 withdraws to the outside of the housing 401 from the inlet/outlet port 417. At this time, the cup 402 is at its lowermost position.

[0051]

After the second washing mechanism 29 retreats, the rotator 404 is rotated by the hollow motor 405, along with which the rotation table 406 is rotated and the wafer W held by the holding members 52 are also rotated. At this time, the cup 402 is lifted to its uppermost position 402' by the cup driving unit 403, in order for the washing liquid or the like not to scatter around in the unit.

[0052]

After the number of rotations of the rotation table 406 reaches a predetermined number of rotations (200 to 300 rpm), washing of the back surface and edge of the wafer W is carried out. In washing the back surface and edge of the wafer W, first, pure water is supplied from the main washing nozzle 414. Subsequently, after there occurs a state where pure water is sufficiently supplied to the surface of the wafer W, the washing liquid is supplied from the edge washing nozzle 415. Washing of the edge is carried

out for a predetermined time (approximately 30 seconds) and then ended when, after the supply of the washing liquid from the edge washing nozzle 415 is stopped, the supply of the pure water from the main washing nozzle 414 is stopped.

[0053]

It is possible to wash portions of the edge of the wafer W that can not be sufficiently washed by the edge washing nozzle 415 due to being held by the holding members 52.

[0054]

Specifically, washing of the held portions of the wafer W is carried out by abruptly changing the number of rotations $\omega 1$ of the rotation table 406 to a number of rotations $\omega 2$ lower than $\omega 1$. After the washing of the edge of the wafer W is carried out for a predetermined time, the number of rotations of the rotation table 406 is lowered from $\omega 1$ to $\omega 2$. In accordance with the lowering of the number of rotations, the pushing force of the holding portion 54 of the holding member 52 exerted on the wafer W is decreased, and held portions 91 of the wafer W that are held by the holding members 52 are shifted to positions 91' in a direction reverse to the rotary direction of the wafer W. Then, by carrying out washing of the edge of the wafer W by returning the number of rotations of the rotation table to $\omega 1$, the portions of the wafer W that have been held by the holding members 52 can also be washed.

[0055]

After the back surface and edge of the wafer W are washed, both surface of the wafer W are washed by pure water while maintaining the same number of rotations. The washing of the wafer W by pure water is carried out for a predetermined time (approximately 40 seconds) with pure water supplied from the main washing nozzle 414 above the wafer W and from the holes 51 of the back surface washing nozzle 409 under the wafer W.

[0056]

After the back surface of the wafer W is washed, spin-drying of the wafer W is performed. The spin-drying is performed for a predetermined time (approximately 10 seconds) by raising the number of rotations of the rotation table 406 to a predetermined number of rotations (2000 to 3000 rpm) and at the same time supplying $N_2$ from the main washing nozzle 414 above the wafer W and from the holes 51 of the back surface washing nozzle 409 thereunder. At this time, the cup 402 is at a lowered position, so that transfer of the wafer W by the second transfer mechanism 29 is not impeded.

[0057]

After the above-described washing and drying process, the wafer W is transferred to the outside of the washing/drying unit 27 from the inlet/outlet port 417 of the housing 401 by the second transfer mechanism 29.

[0058]

In the present embodiment, the wafer W is held on the rotation table by three holding members. However, the wafer W may be held by three or more holding members.

[0059]

In the above-described embodiment, the washing liquid discharged from the edge washing nozzle 415 is a mixture liquid of rare hydrofluoric acid and $H_2O_2$. However, rare hydrofluoric acid and $H_2O_2$ may be supplied from different tanks storing them separately, and may be mixed immediately in front of the edge washing nozzle 415.

[0060]

The placement of the edge washing nozzle 415 may be variously changed. By optimizing the angle of the edge washing nozzle with respect to the plane of the wafer W, and the angle thereof with respect to the radial direction of the wafer W, it is possible to control the washing width of the wafer W to a desired value.

[0061]

Further, in the present embodiment, the supply rate of the pure water from the main washing nozzle 414 and the supply rate of the washing liquid from the edge washing nozzle 415 are predetermined values. However, they may be changed. A desired washing width can be obtained by setting the placement of the edge washing nozzle 415 based on changes of the supply rate.

[0062]

The washing apparatus of the present embodiment is designed such that the edge washing nozzle 415 is arranged at one point. However, it may be designed such that a plurality of edge washing nozzles 415 are provided whereby the wafer W is washed.

[0063]

Furthermore, by changing the structure of the back surface washing nozzle 409 used in the above-described examples 1 and 2, a more effective washing of a substrate is available.

[0064]

The back surface washing nozzle 409 is constituted by four rod members radiately extending from the center toward the outside, and the washing liquid and pure water are supplied to the back surface of the wafer W from seven holes 51 provided in the upper side of the rod members. Then, as shown in FIG. 5, these holes 51 are designed such that one of them is arranged at the center, and three of them are lined on each rod member at regular intervals from the center. All of the holes have the same diameter.

[0065]

However, since the wafer W is a circle, the central region and end region of the wafer W require different amounts of washing liquid per area. For example, in a case where the wafer W is divided into three regions by dividing the radius of the wafer W equally, the area ratio among the regions is central region : intermediate region : end region = 1 : 3 : 5, which means that the amounts of washing liquid are different among the regions.

[0066]

The difference in the amount of washing liquid splashed on each region on the surface of the wafer W is adjusted by increasing the diameter of the holes from the central region toward the end region. For example, in a case where the wafer W is divided into three regions as described above, it is possible to equate the amounts of washing liquid splashed on the respective regions on the surface of the wafer W, by adjusting the ratio of total area of holes in each region to be central region : intermediate region : end region = 1 : 3 : 5.

[0067]

Further, since the wafer W is rotated, the central region and end region of the wafer W differ in the area that can be washed with a supplied amount of liquid. Therefore, it is possible to adjust by changing the diameter of the holes with respect to the angular velocity of rotation of the wafer W. For example, in a case where the wafer W is divided into three regions likewise the above, the ratio of angular velocity among the regions is central region : intermediate region : end region = 1 : 2 : 3. Therefore, it is possible to equate the amounts of washing liquid splashed on the respective regions on the surface of the wafer W, by adjusting the ratio of total area of holes in each region to be central region : intermediate region : end region = 1 : 2 : 3.

[0068]

Since actually the washing by the nozzle is performed while the circular wafer W is rotated, combination of the above two approaches is preferred. At this time, in a case where the surface of the wafer W is divided into three, the optimum value for the ratio of total area of holes in each region is central region : intermediate region : end region = 1 : 2.5 : 4.

[0069]

In the above-described embodiment, the nozzle holes are set by dividing the wafer W into three regions based on the radius thereof. However, the nozzle holes may be set more specifically, by dividing the region into four or by

other ways.

[0070]

The number of holes of the back surface washing nozzle is seven in each rod member, but may be arbitrarily set. Further, the number of rod members is four, but may be arbitrarily set to such as six, etc.

[0071]

Or, the holes may be assigned to the divided regions differently in number, while the diameter of the holes is maintained equal. For example, in a case where the wafer W is divided into three regions, the ratio of liquid amount to be supplied to each region is 1 : 2.5 : 4 and the holes are arranged correspondingly in number to this ratio. The ratio of numbers to be arranged in the respective regions may need to be optimized, regardless of the number of the rod members. That is, the ratio of the number of holes may be central region : intermediate region : end region = 1 : 2.5 : 4. Accordingly, the number of holes to be arranged in each rod members may be varied. Thus, the back surface washing nozzle 409 may not be limited to the structure constituted by rod members, but may be structured such that holes are arranged in a disk.

[0072]

In the above-described embodiment of the present invention, there has been explained a case where a semiconductor wafer is subjected to liquid processing. However, the liquid processing apparatus of the present invention can be applied to processing of a glass substrate or the like for an LCD, in addition to a semiconductor wafer as a processing target.

[0073]

[Effects of the Invention]

As explained above, according to the present invention, there is provided a liquid processing apparatus which can wash the edge of a substrate without giving an adverse influence on a device. Further, according to the present

invention, there is provided an apparatus for washing the edge of a plated semiconductor wafer, making it possible to restrict generation of particles peeled from the wafer edge and to prevent a carrier and the like from being polluted.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a schematic three-dimensional cubic diagram showing the entire structure of a plating apparatus according to an embodiment of the present invention.

[FIG. 2]

FIG. 2 is a schematic plan view showing the entire structure of the plating apparatus according to the embodiment.

[FIG. 3]

FIG. 3 is a schematic side view showing the entire structure of the plating apparatus according to the embodiment.

[FIG. 4]

FIG. 4 is a cross section of a washing/drying unit according to the embodiment of the present invention.

[FIG. 5]

FIG. 5 is a top view of a back surface washing nozzle 409 according to the embodiment.

[FIG. 6]

FIG. 6 shows a side view and front view of a holding member 52 for a wafer according to the embodiment.

[FIG. 7]

FIG. 7 is a diagram showing a method of washing the edge of a wafer according to the embodiment.

[FIG. 8]

FIG. 8 is a diagram showing a method of washing the edge of a wafer

according to the embodiment.

[FIG. 9]

FIG. 9 is a diagram showing a sequence for washing and drying a wafer according to the embodiment.

[FIG. 10]

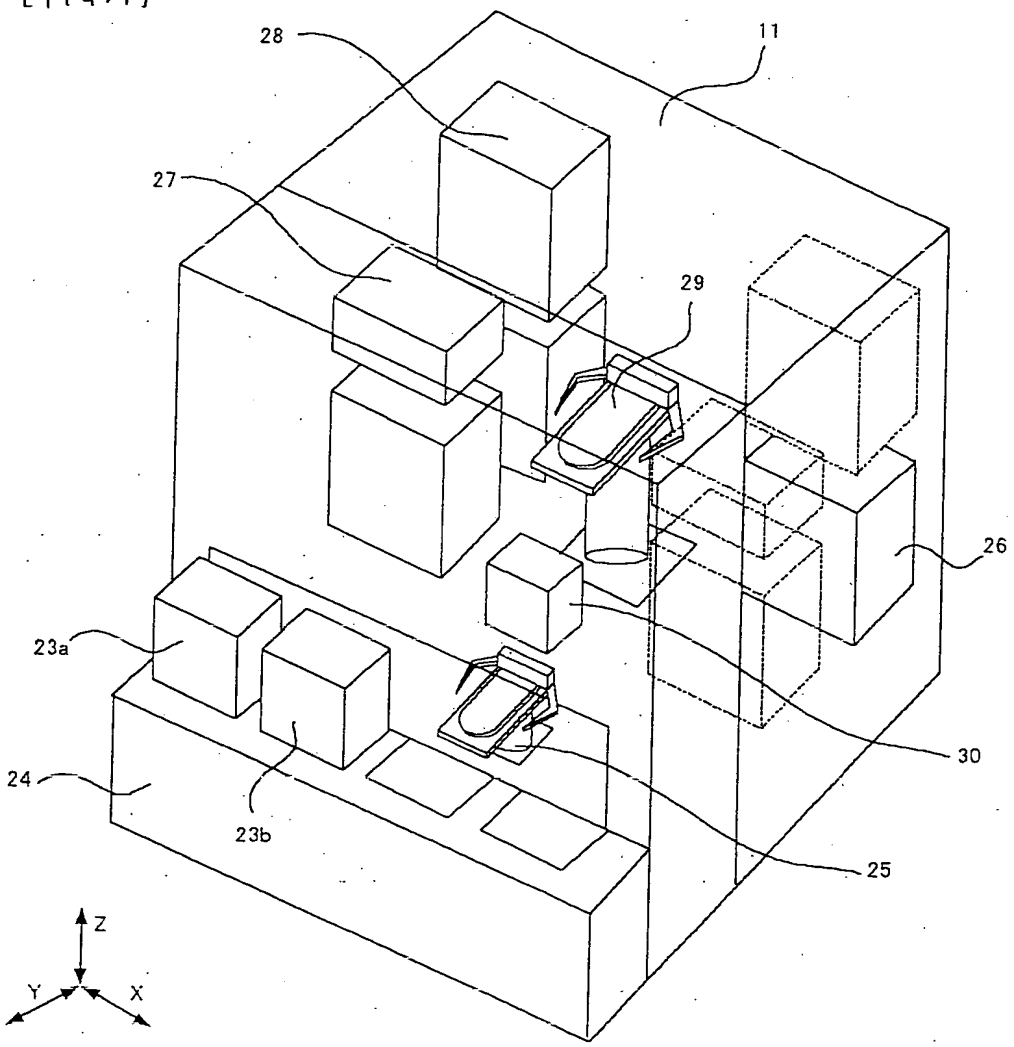
FIG. 10 is a diagram showing shifting of a wafer according to the embodiment.

[Explanation of Reference Numerals]

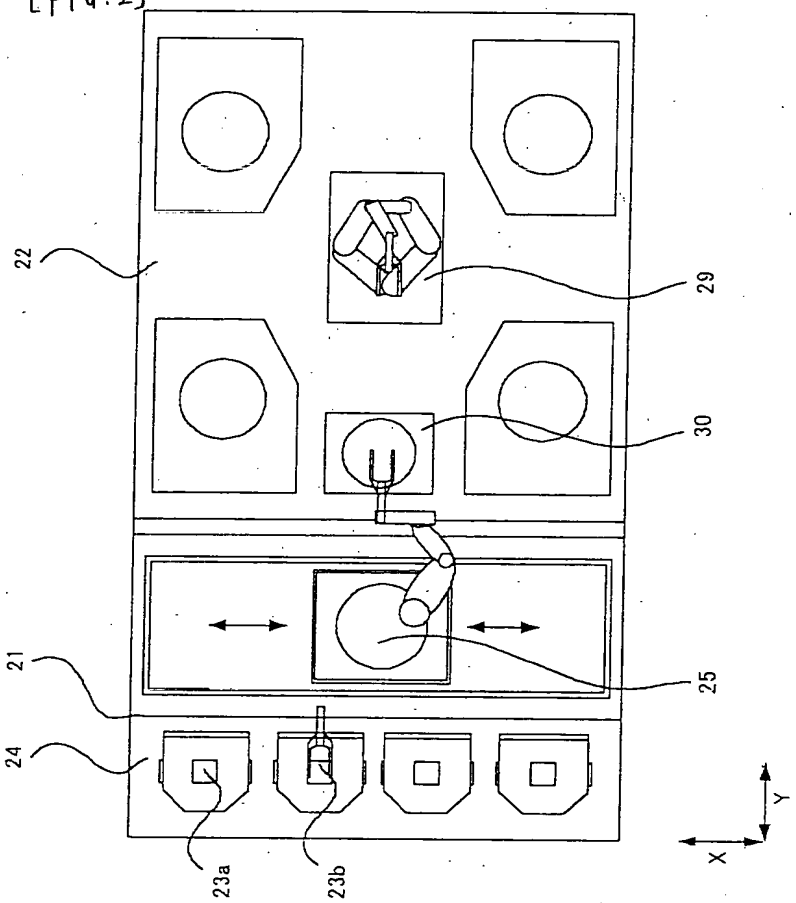
11 plating apparatus
21 cassette station
22 processing station
23 wafer cassette
25 first transfer mechanism
26 plating unit
27 washing/drying unit
28 extra unit
29 second transfer unit
402 housing
405 hollow motor
406 rotation table
409 back surface washing nozzle
414 main washing nozzle
415 edge washing nozzle
52 holding member
W wafer

【書類名】　図面
[NAME OF DOCUMENT]　DRAWING

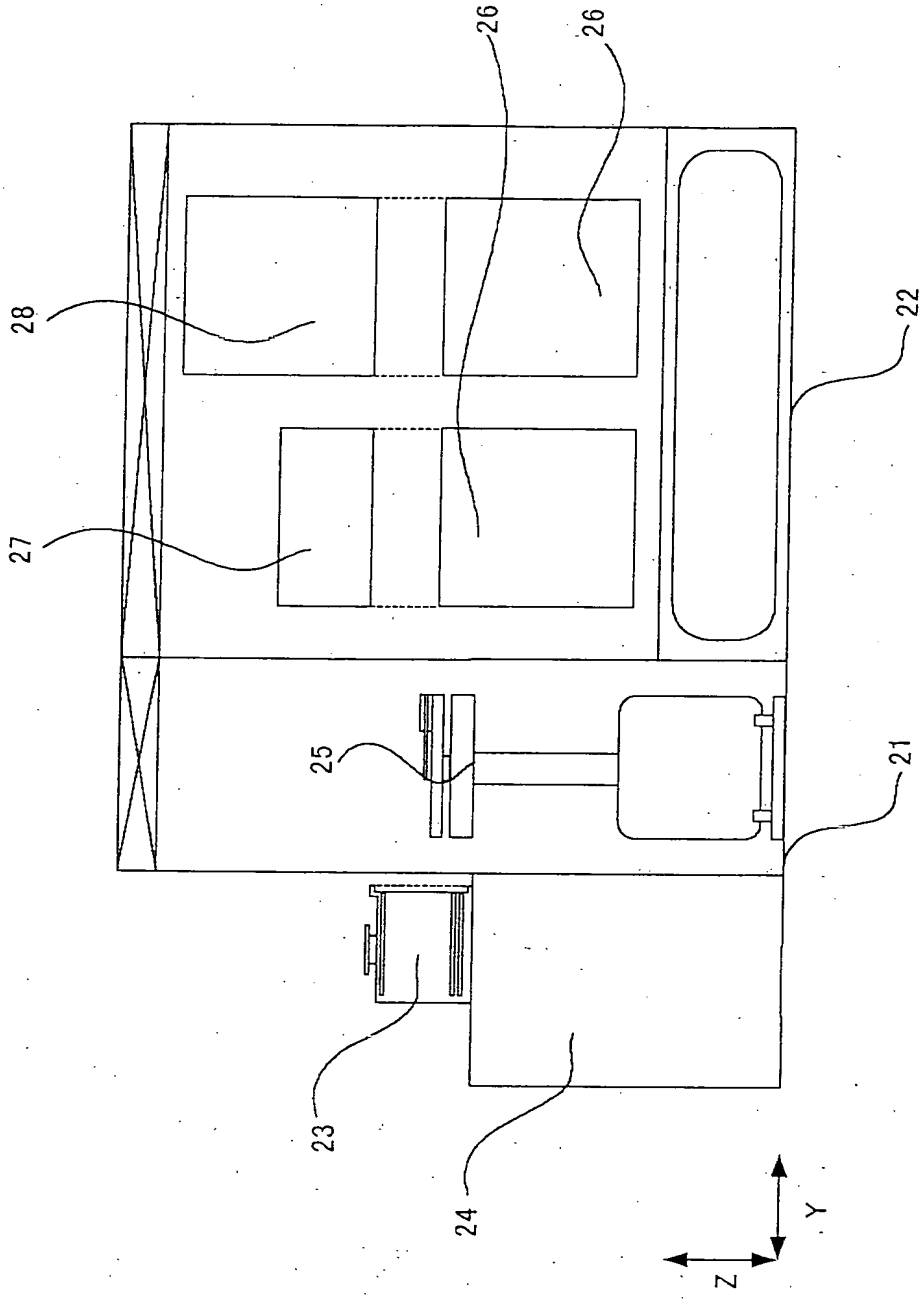
【図１】
[FIG. 1]



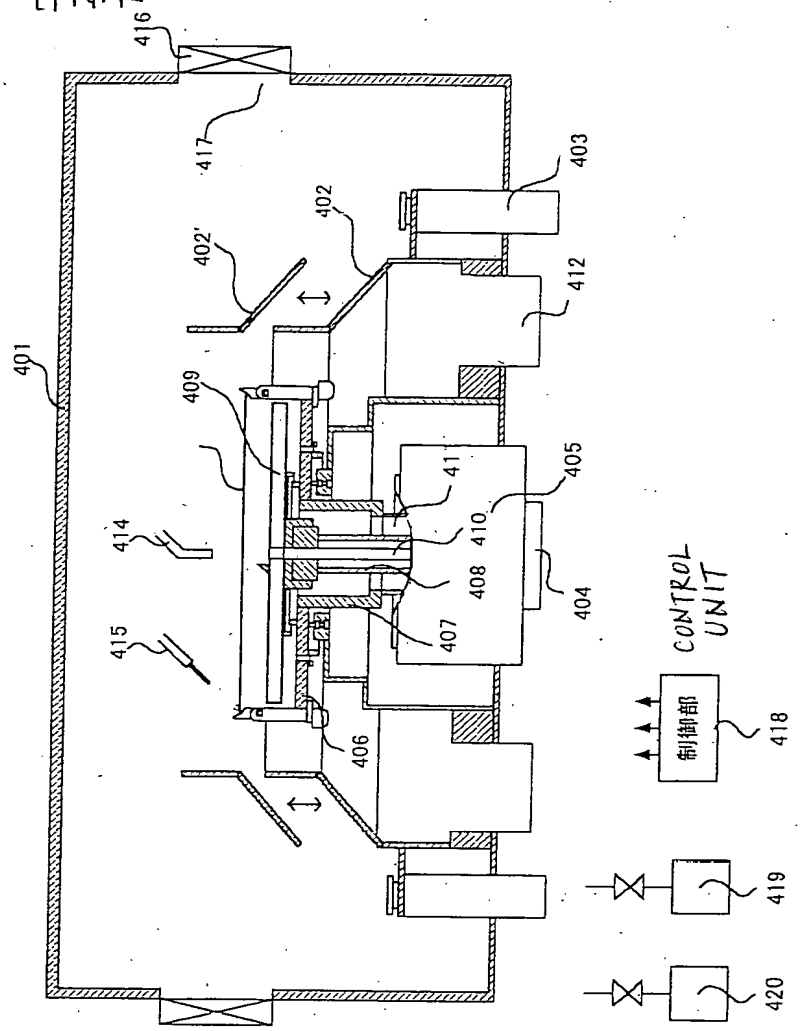
【図２】
[FIG.2]



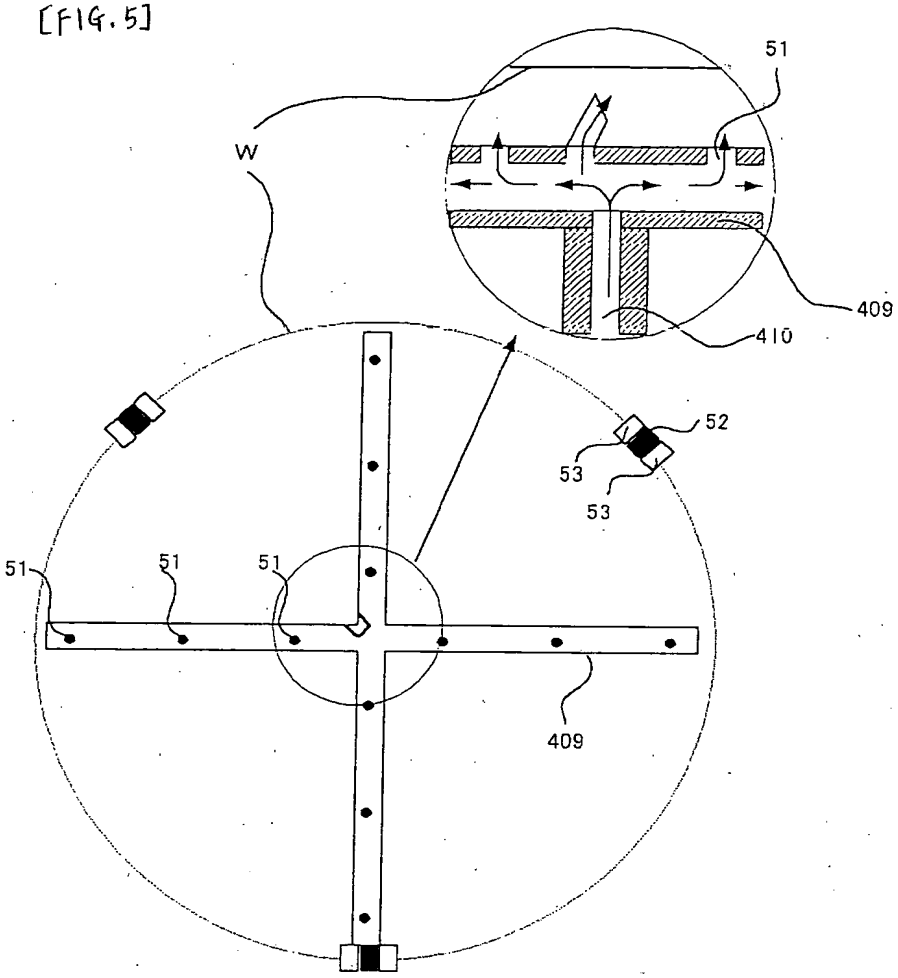
【図３】
[FIG.3]



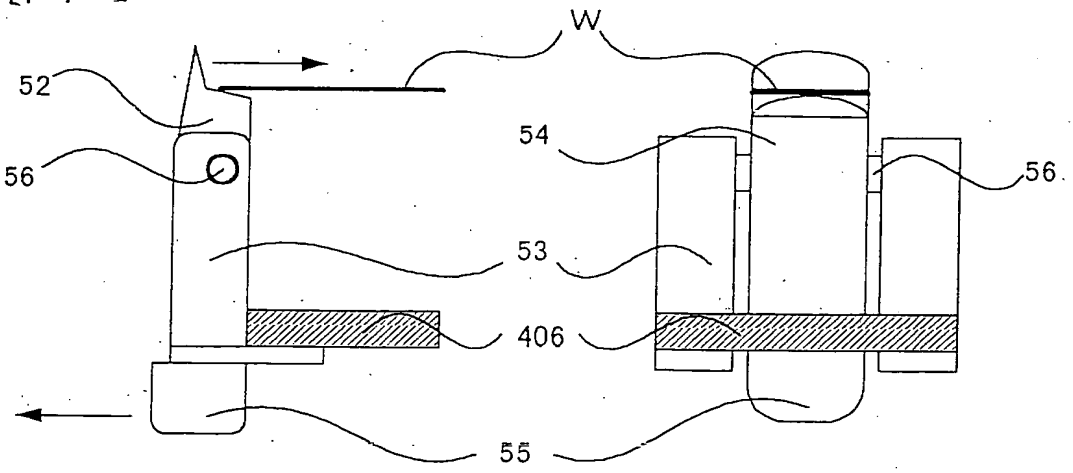
【図４】
[FIG.4]


416
417
403
402
402'
412
401
409
411
405
410
414
408
404
407
415
406
CONTROL UNIT
制御部
418
419
420

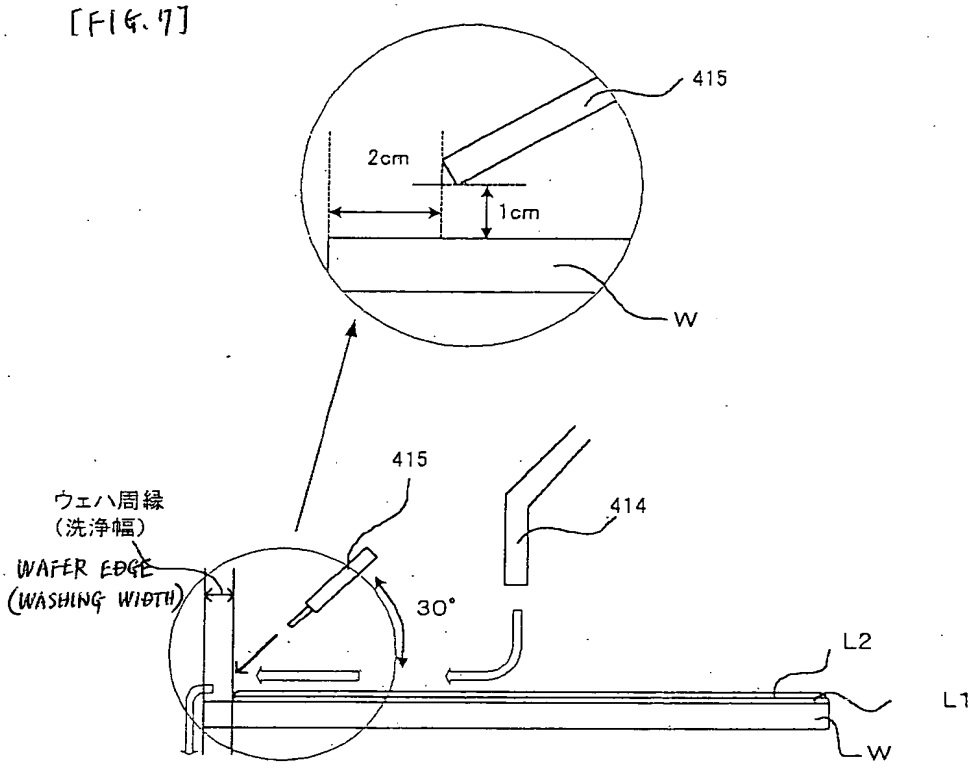
【図５】
[FIG.5]



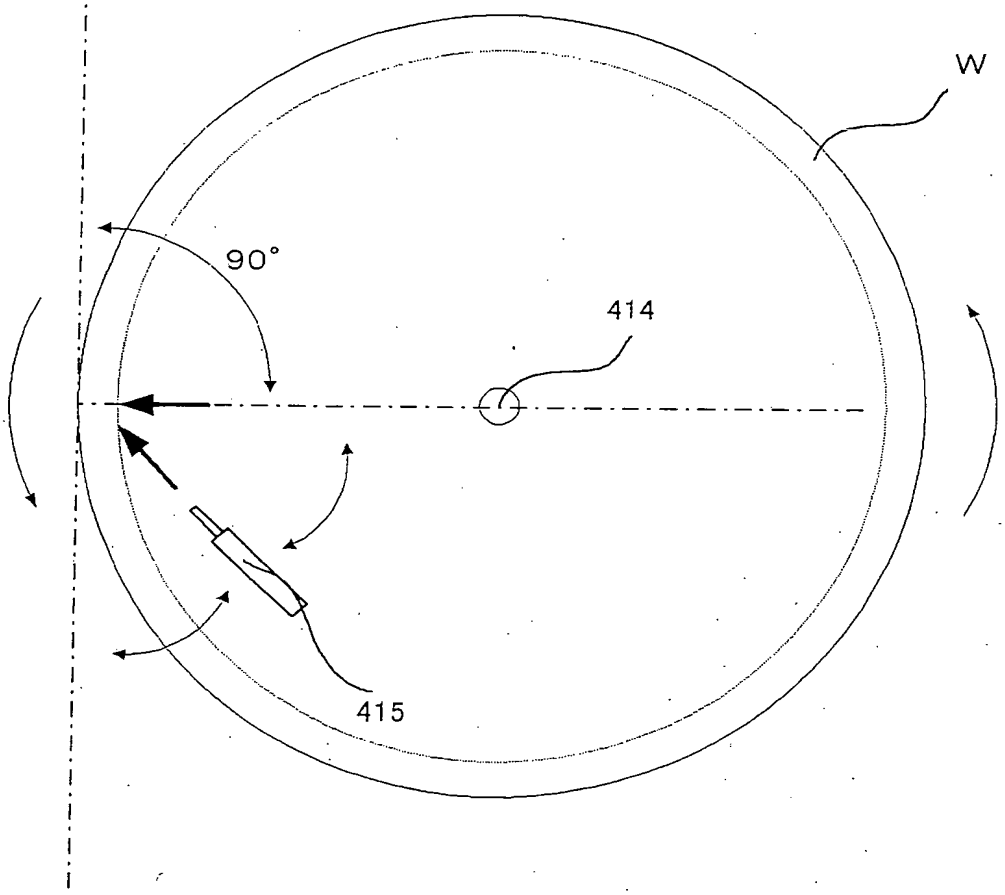

【図６】
[FIG.6]



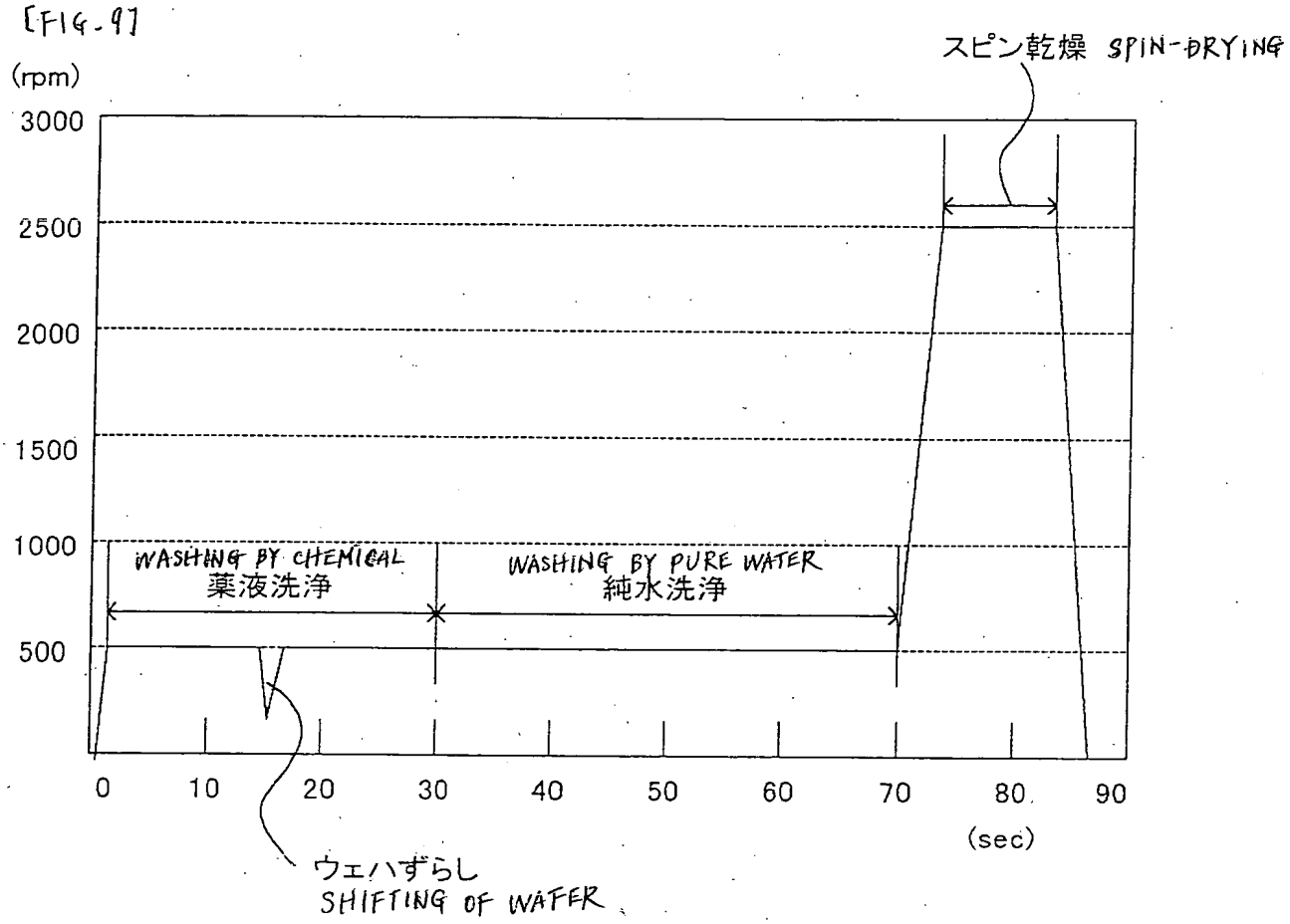
【図７】
[FIG. 7]


415
2cm
1cm
W
415
414
ウェハ周縁
(洗浄幅)
WAFER EDGE
(WASHING WIDTH)
30°
L2
L1
W

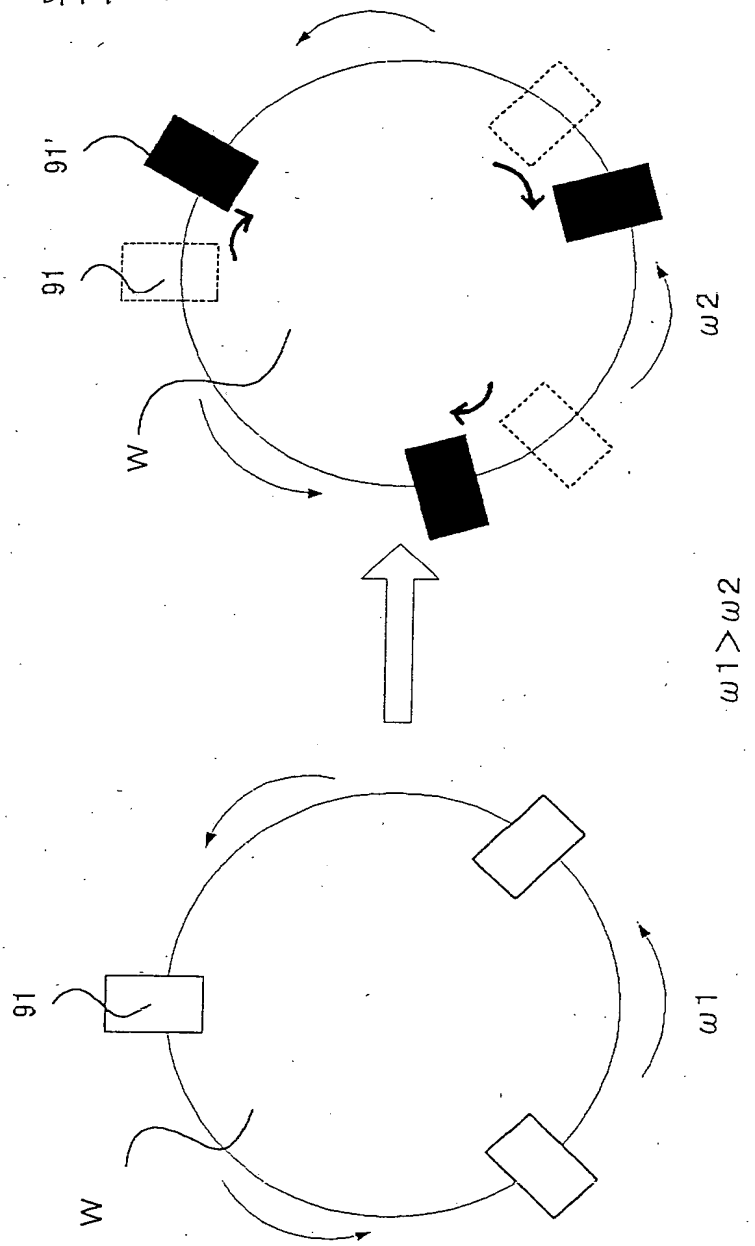
【図８】
[FIG. 8]



【図９】
[FIG.9]


スピン乾燥 SPIN-DRYING
(rpm)
3000
2500
2000
1500
1000
500
WASHING BY CHEMICAL
薬液洗浄
WASHING BY PURE WATER
純水洗浄
0
10
20
30
40
50
60
70
80
90
(sec)
ウェハずらし
SHIFTING OF WAFER

【図１０】
[FIG.10]



[Name of Document] Abstract

[Abstract]

[Object] To provide a substrate washing apparatus which can wash the edge of a substrate without giving an adverse influence to a device.

[Solution] By splashing a chemical to the edge of a substrate while supplying a washing liquid such as pure water, etc. to the central region of the substrate surface, the splashed chemical and dissolved products of thin films are prevented from scattering to the substrate surface. Further, when the edge of the substrate is washed while the substrate is rotated, by changing the number of rotations of the substrate to weaken the pushing force applied to the held portion of the substrate that is held and to shift the portion of the substrate to be held, it is possible to wash the entire edge of the substrate

[Selected Drawing] FIG. 6

# APPLICANT'S PAST DATA

| | |
|---|---|
| Identification Number | [000219967] |
| 1. Date of Change | September 5, 1994 |
| [Reason of Change] | Change of Address |
| Address | 3-6, Akasaka 5-chome, Minato-ku, Tokyo |
| Name | TOKYO ELECTRON LIMITED |